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ABSTRACT

Forty-one 10th grade biology tests prepared by commercial publishers, test bureaus, and the Biological Sciences Curriculum Study were analyzed using the six major categories of Bloom's Taxonomy of Educational Objectives Handbook I: Cognitive Domain. Of the 2,689 test items classified, 71.88% were Knowledge, 15.17% Comprehension, 11.49% Application, 1.37% Analysis, 0.04% Synthesis, and 0.04% Evaluation. Tables showing the percentage of items at each level for each test are given. Only BSCS tests reflected levels above Application, and of these, only the Process of Science Test used all six levels of the Taxonomy. A check on the classification of the items by a panel of twelve judges produced an overall agreement of 83.9%. (AL)

COGNITIVE LEVELS OF TEST ITEMS IN COMMERCIAL BIOLOGY EXAMINATIONS

Paper Presented at the

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INTRODUCTION

Evaluation is a necessary task of teaching, as is planning and grading. Teachers are seldom trained as test specialists and usually rely on whatever experience they receive in their professional education courses, if any, or depend on their past experiences as a student in order to construct a test. For any one of a number of reasons the teacher might choose to measure student achievement by using a commercial test.

PROBLEM

Commercially prepared tests are assumed to be the product of test specialists, developed and supported by an elaborate testing organization. It is reasonable to expect that some commercial tests would measure more than just memory and recall of facts. One might also anticipate that some tests could be identified which exhibit purposes similar to the teacher's course objectives. From the test description it may not be obvious which levels of thinking the test will evaluate.

If a teacher has outlined specific skills and objectives for a course and then chooses to use a standardized test to measure achievement in these skills, it is assumed the teacher might wish to know more about the types of questions in the test.

The selection of a standardized test may unintentionally determine teaching style and content approach in order to improve individual achievement scores. A cautionary note was offered in one discussion of the criticisms of intelligence and aptitude tests.

> "Although less often perceived as unfair, since they measure skills acquired in a particular area over a short time, achievement tests potentially exert a considerable influence on subject matter and teaching methods, as well as on what skills appear desirable."[1]

It is proposed that it would be useful to identify the types of thinking tasks required of testees, and in so doing, to describe and classify tests according to cognitive tasks. The teacher could then select the test which emphasizes that type of question or which contains the cognitive levels necessary to meet the needs of the individual test situation. No study was found which described in cognitive terms the individual items of the many existent biology tests. The following is an abstract of such a study, using Bloom's Taxonomy[2] to classify test items.

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1. Goslin, D.A. "Standardized Ability Tests and Testing," Science, 159 (3817): 851-855. February 23, 1968.

2. Bloom, Benjamin S. (ed.). Taxonomy of Educational Objectives Handbook I: Cognitive Domain. New York: David McKay Co., 1956.

ABSTRACT [1]

Forty-one tenth grade biology tests from commercial publishers, test bureaus, and the Biological Sciences Curriculum Study (BSCS) were analyzed using the six major levels of Bloom's Taxonomy of Educational Objectives Handbook I: Cognitive Domain. Two research questions were posed. What percent of test questions found in standardized and commercial tenth grade biology examinations is represented by each of the six levels of the Taxonomy? Do tests of the BSCS contain more items which measure higher cognitive levels than do other standardized or commercially prepared tests?

A total of 2,689 test items were classified with 1,933 questions identified as level 1.00 Knowledge; 408 as level 2:00 Comprehension; 309 as level 3.00 Application; 37 as level 4.00 Analysis; one as level 5.00 Synthesis; and one as level 6.00 Evaluation. Percentages for each level were 71.88% Knowledge; 15.17% Comprehension; 11.49% Application; 1.37% Analysis; 0.04% Synthesis; and 0.04% Evaluation. Only 39 items, or 1.45%, were above level 3.00.

A panel of twelve distinguished judges, including four contributors to the Taxonomy, was used to validate the investigator's competency in classifying test items. A random, proportional xample of 56 items was prepared for the judges to agree or disagree with the classifications of the sample items (model). The model contained 38 Knowledge items, 8 Comprehension, 6 Application, 2 Analysis, one Synthesis, and one Evaluation. Agreements with the model ranged from a high of 90.4% on level 1.00 items to a low of 33.3% for the single level 5.00 item. The overall agreement was 83.9% for all judges for all sample items. When higher levels of 3.00, 4.00, 5.00, and 6.00 were combined, the agreement was 65.2% for the grouping. Greater agreement was realized for levels 1.00 and 2.00 than for the upper levels. When items rated higher than the model were included as agreeing with the model, the accumulative agreement with the sample items was raised from an overall 83.9% to 92.2%.

Each test used in this study was described by percent totals of items in each of the six Taxonomy categories. Very few tests other than BSCS tests reflected more than 10% questions above level 2.00. Five tests were totally level 1.00. Eleven of the tests had level 1.00 questions in excess of 90% of their total. Only BSCS tests reflected levels above 3.00. One test, the BSCS Process of Science Test (POST), contained one question each for levels 5.00 and 6.00. No other test was found which contained these two levels of questions. The POST provided a wider utilization of the six cognitive levels of the Taxonomy than any other test studied. Of the forty items on the POST, fifteen were Knowledge, ten were comprehension, four were Application, nine were Analysis, one was Synthesis, and one was Evaluation.

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[1]Pancella, John R. "Use of the Taxonomy of Educational Objectives Handbook I: Cognitive Domain (Bloom) to Analyze and Describe Standardized and Commercial Tenth Grade Biology Examinations," Doctoral Dissertation, Ed. D., University of Maryland, 1970.

Recommendations include the following:

1. Standardized and commercial tenth grade biology examinations other than the BSCS tests should not be used to measure cognitive levels above 2.00 Comprehension.

2. The POST could be used as a model for teachers who wish to develop tests to measure cognitive processes higher than Knowledge.

3. Pre-service and in-service biology teachers should receive in-depth training in the Taxonomy to help them analyze existent examinations and to help them generate better ones.

4. A future study should be done to compare present examinations with newer ones, to observe whether or not the impact of the recent emphasis on teaching for the process of science and problem solving, rather than fact recall, is being reflected in the examinations.

The summary outline which follows lists the examinations used and the percent total of each Taxonomy level in each test.

Forty-one Different Biology Tests Analyzed

Test Title	Total Items	Per cent of Each Taxonomy Level 1.00	2.00	3.00	4.00	5.00	6.00
1. BSCS Biological Science: Patterns and Processes, Achievement Test 1, 1966	45	22.0	60.0	17.8	0.0	0.0	0.0
2. BSCS Biological Science: Patterns and Processes, Achievement Test 2, 1966	45	42.2	31.1	22.2	4.4	0.0	0.0
3. BSCS Biological Science: Patterns and Processes, Achievement Test 3, 1966	45	60.0	20.0	20.0	0.0	0.0	0.0
4. BSCS Biological Science: Patterns and Processes, Achievement Test 4, 1966	45	46.7	22.2	31.1	0.0	0.0	0.0
5. BSCS Biological Science: Patterns and Processes, Achievement Test 5, 1966	45	42.2	26.7	31.1	0.0	0.0	0.0
6. BSCS Biological Science: Patterns and Processes, Achievement Test 6, 1966	45	44.4	13.3	37.8	4.4	0.0	0.0
7. BSCS Biological Science: Patterns and Processes, Final Examination, 1966	50	52.0	24.0	22.0	2.0	0.0	0.0
8. BSCS Blue Version, Achievement Test 1, Form R, 1964	45	53.3	40.0	4.4	2.2	0.0	0.0
9. BSCS Blue Version, Achievement Test 2, Form R, 1964	45	73.3	6.7	20.0	0.0	0.0	0.0

Test Title	Total Items	Per cent of Each Taxonomy Level 1.00	2.00	3.00	4.00	5.00	6.00
10. BSCS Blue Version, Achievement Test 3, Form R, 1964	45	48.9	13.3	37.8	0.0	0.0	0.0
11. BSCS Blue Version, Achievement Test 4, Form R, 1964	45	42.2	35.5	15.6	6.7	0.0	0.0
12. BSCS Green Version, Achievement Test 1, Form R, 1964	45	11.1	33.3	48.9	6.7	0.0	0.0
13. BSCS Green Version, Achievement Test 2, Form R, 1964	45	17.8	37.8	37.8	6.7	0.0	0.0
14. BSCS Green Version, Achievement Test 3, Form R, 1964	45	46.7	20.0	28.9	4.4	0.0	0.0
15. BSCS Green Version, Achievement Test 4, Form R, 1964	45	35.6	22.2	42.2	0.0	0.0	0.0
16. BSCS Yellow Version, Achievement Test 1, Form R, 1964	45	40.0	31.1	26.7	2.2	0.0	0.0
17. BSCS Yellow Version, Achievement Test 2, Form R, 1964	45	35.6	26.7	31.1	6.7	0.0	0.0
18. BSCS Yellow Version, Achievement Test 3, Form R, 1964	45	40.0	28.9	26.7	4.4	0.0	0.0
19. BSCS Yellow Version, Achievement Test 4, Form R, 1964	45	31.1	24.4	44.4	0.0	0.0	0.0
20. BSCS Comprehensive Final Test, Part I, 1965	50	60.0	22.0	16.0	2.0	0.0	0.0
21. BSCS Comprehensive Final Test, Part II, 1965	50	54.0	22.0	16.0	8.0	0.0	0.0
22. BSCS Processes of Science Test, Form A, 1962	40	37.5	25.0	10.0	22.5	2.5	2.5

Test Title	Total Items	Per cent of Each Taxonomy Level 1.00	2.00	3.00	4.00	5.00	6.00
23. Biology Test, First Semester, Revised, 1962	60	90.0	5.0	5.0	0.0	0.0	0.0
24. Biology Test, Second Semester, Revised, 1962	60	91.7	8.3	0.0	0.0	0.0	0.0
25. California Tests in Social and Related Sciences, Part III, Test 6, Biological Science, 1954	93	76.3	23.7	0.0	0.0	0.0	0.0
26. Cooperative Biology Test, ERB Edition, Form TZ, 1965	75	74.7	25.3	0.0	0.0	0.0	0.0
27. Cooperative Science Test, Biology, Form A, Part I, 1963	60	75.0	11.7	13.3	0.0	0.0	0.0
28. Cooperative Science Test, Biology, Form A, Part II, 1963	60	88.3	11.7	0.0	0.0	0.0	0.0
29. Emporia Biology Test I, Form A, 1964	115	100.0	0.0	0.0	0.0	0.0	0.0
30. Emporia Biology Test II, Form A, 1964	105	100.0	0.0	0.0	0.0	0.0	0.0
31. Every Pupil Scholarship Test, Biology, April 14, 1965	60	96.7	1.7	1.7	0.0	0.0	0.0
32. First Every Pupil Test, Biology, Nov. 30 - Dec. 4, 1964	72	79.2	20.8	0.0	0.0	0.0	0.0
33. Minnesota High School Achievement Examination, Biology, Form EH, 1965	107	99.1	0.0	0.9	0.0	0.0	0.0
34. National Achievement Test, General Biology Test, Form A, Part I, Part II, Part III, 1958	120	96.7	3.3	0.0	0.0	0.0	0.0
35. Nelson Biology Test, Revised Edition, Form E, 1965	65	69.2	20.0	10.8	0.0	0.0	0.0

Test Title	Total Items	Per cent of Each Taxonomy Level 1.00	2.00	3.00	4.00	5.00	6.00
36. Preliminary District State Scholarship Test, Biology, 1965	114	96.5	0.0	3.6	0.0	0.0	0.0
37. Second Every Pupil Test, Biology, April 5-9, 1965	80	50.0	37.5	12.5	0.0	0.0	0.0
38. Survey Test in Biological Science, Form 1, 1959	93	74.2	17.2	8.6	0.0	0.0	0.0
39. 20th Century Semester Test for Biology, Semester I, 1959	125	100.0	0.0	0.0	0.0	0.0	0.0
40. 20th Century Semester Test for Biology, Semester II, 1959	125	100.0	0.0	0.0	0.0	0.0	0.0
41. Williams Biology Test I, Form A, 1934	100	100.0	0.0	0.0	0.0	0.0	0.0